

ROLE OF OVARIAN HORMONES IN HOARDING PATTERN

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Summary : Hoarding pattern studied in 28 adult female albino rats indicated cyclic changes in hoarding corresponding to alterations in estrus cycle. It was observed that the hoarding score was maximum at proestrus and the least at diestrus. Animals ovariectomised at proestrus maintained higher hoarding score and those ovariectomised at diestrus stabilised on lower hoarding score. Progesterone administration reduced the score in high-score group and Oestrogen administration improved the score in low score group. Alterations in ovarian hormone levels were thus observed to influence hoarding pattern in rats.

Key words : female rats
injection progesterone

cyclicity in hoarding
ovariectomy

stabilisation of hoarding
injection oestrogen

INTRODUCTION

Rodents are known to hoard large quantities of food under different environmental conditions (14). The tendency to hoard is especially enhanced during chronic food deprivation (13). It was further observed that the sensory consequences resulting from any of the deficits of food constituents did not alter the hoarding (14).

Hoarding of food by rodents is of particular interest because of its relevance to many appetitive activities in rats and which are not directed to the immediate alleviation of a physiological need (4). This is an anticipatory response to the possible adverse situations which may have to be encountered like extremes of environmental temperatures, nutritional deficiency and pregnancy in future. It is known that the rats hoard large quantities of food when external temperature falls (14). Long term food deprivation resulting into cumulative effect of food restriction on the body has a pronounced influence on hoarding. However, lack of any of the major dietetic constituents or vitamin deficiencies brought about experimentally did not enhance the hoarding score (13). Thyroidectomy or administration of thyroid extracts did not alter the hoarding behaviour.

Female rats are known to exhibit cyclic pattern of locomotor activities in the estrus cycle (3) and alterations in body weight and food intake (7, 17). These animals hoard

food when deprived and unlike male rats continue hoarding though at a lower rate even though sufficient food is available (4, 11, 15). The hoarding in females has cyclic pattern related to the cyclic changes observed in estrus cycle. During food deprivation they tend to hoard more food at proestrus as compared to the hoarding score at estrus (5). The present work confirms this report and further indicates that the score is least in diestrus. It was therefore, planned to elucidate the role of female sex hormones in hoarding in the female rats.

MATERIAL AND METHOD

The study was carried out in 28 adult female albino rats (Haffkine strain) weighing between 170–200 *gms*. They exhibited regular estrus cycles of 4 to 5 days duration as determined by microscopic inspection of vaginal cytology which was carried out at 9 A.M. every day. The mean food intake in all animals was determined for 10 days before the experiment in a separate cage where the animals had free access to food and water. They were then kept and trained to hoard food by placing them in a cage specially constructed for the purpose. This cage consisted of dark home cage 45 *cms* long, 35 *cms* broad and 40 *cms* high and could be opened on the top whenever necessary. A wooden partition with guillotine door was placed on one side of cage making a partition of about 15 *cms* long. About 200 food pellets each weighing approximately 5 *gms* were kept in this compartment and the animals were allowed to have free access and pick up for purposes of hoarding these pellets for 30 min at 9–30 in the morning. When trained to hoard they were observed to carry the food pellets to the home cage during this period. Remaining pellets from the partition cage were removed after 30 min., the number of pellets hoarded was counted (hoarding score) and the animals were allowed to consume the food from the hoarded stock for subsequent 90 min. At the end of 90 min the pellets from the home cage were removed and weighed in order to determine the total food intake during the period of 2 hr. Water was provided to the animals in the home cage throughout the 24 hours.

All the animals were randomly grouped into two for purpose of ovariectomy. In group I of 13 animals bilateral ovariectomy was performed under ether anaesthesia during proestrus. In the other 10 animals of group II the operation was carried out in diestrus. In sham-operated series consisting of 5 animals the bilateral incision was taken in both the flanks and ovaries exposed and touched. The abdominal wound was closed and the hoarding score determined together with the other two experimental groups. It was observed that the animals in group I kept a higher stabilised score and those in group II exhibited a lower stabilised score. The sham operated animals continued to maintain the cyclic hoarding pattern. On 10th day of the operation the group I animals were then administered progesterone subcutaneously in the dose of 2 *mg/kg* diluted in

0.2 ml of groundnut oil every fourth day for 20 days. The animals in group II received injections of estradiol benzoate subcutaneously in the dose of 10 $\mu\text{g}/\text{kg}$ diluted in 0.2 ml groundnut oil every fourth day for 20 days. The body weight, food intakes and hoarding scores were determined after the hormonal treatment.

RESULTS AND DISCUSSION

It was observed in general that the female rats, when kept on restricted food schedule of 2 hours for 8 days reduced the food intake and body weight upto about 15 percent. They exhibited the usual vaginal cycles and cyclic vaginal pattern of hoarding when allowed to hoard food pellets for 30 minutes. The animals showed a tendency to hoard more food

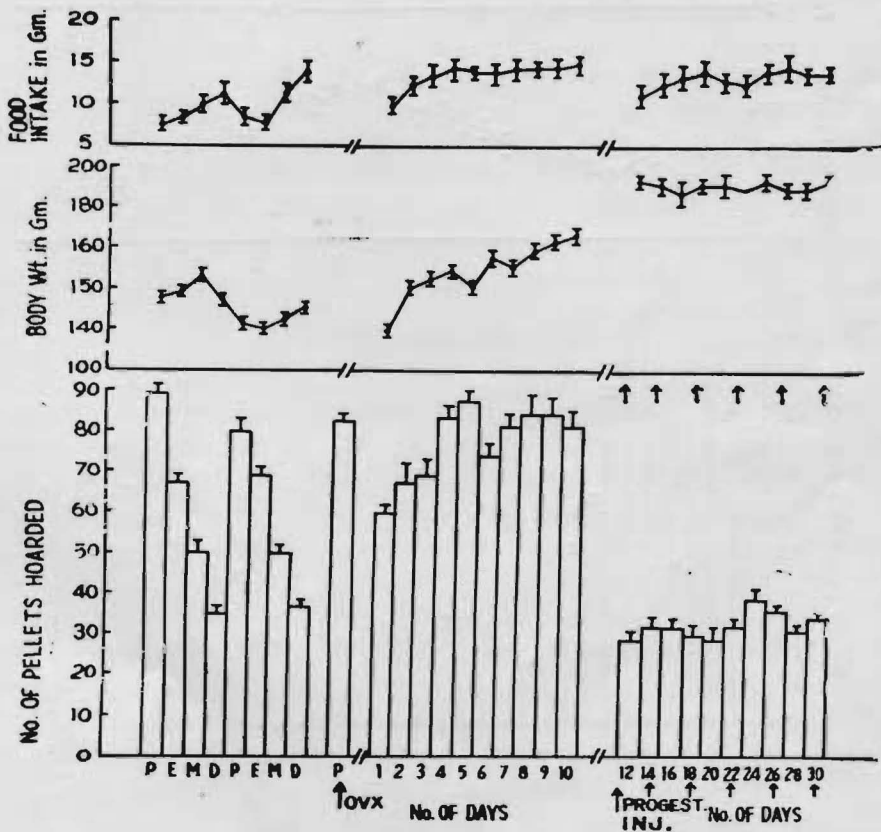


Fig. 1 : Hoarding Score (Number of pellets hoarded in 30 minutes), Food intake and body weights during two estrus cycles alterations after ovariectomy and after progesterone injections in 13 female rats. Mean \pm S.E.M. Post-ovariectomy hoarding score significantly decreased on injection of Progesterone ($P < .01$).

P - Proestrus E - Estrus M - Metestrus
D - Diestrus Ovx - Ovariectomy.
Arrow pointed upwards (\uparrow) indicates the days of injections.

during proestrus, the score reduced in estrus and was the least in diestrus. All the subjects were observed to eat food at variable intervals during 30 minutes of hoarding. The food intake computed for 120 minutes and the body weights were the lowest at estrus and showed an increase after ovariectomy. Slight decrease in food intake and body weight was seen after estrogen administration. No marked alterations were observed

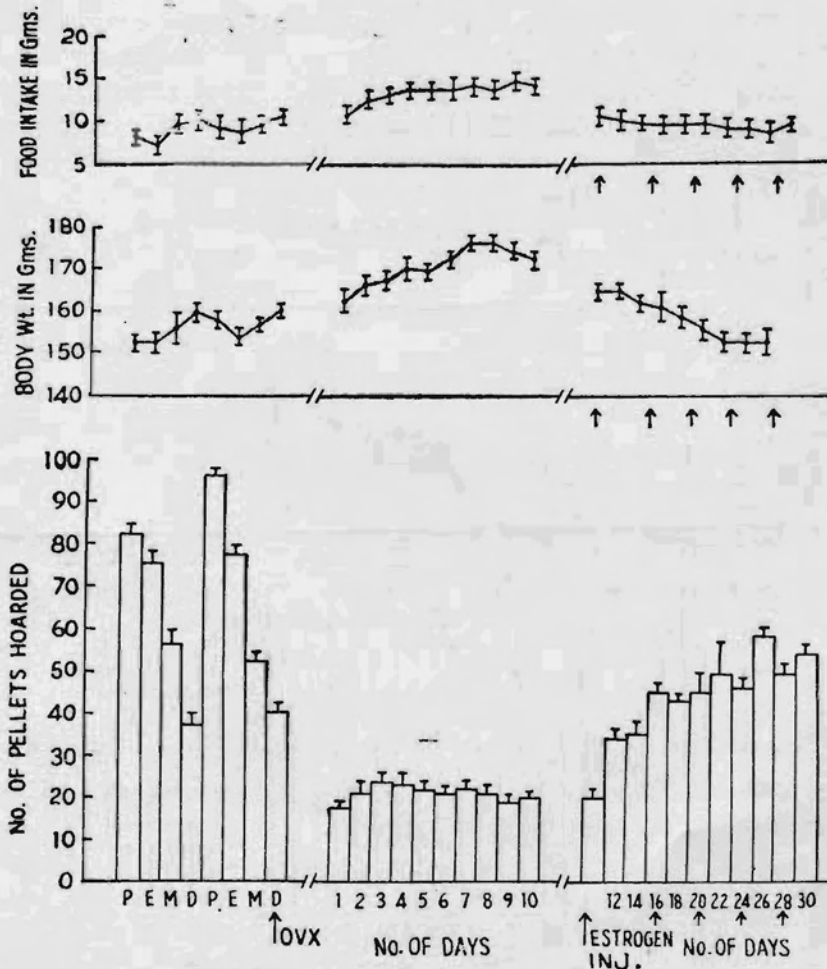


Fig. 2 : Hoarding Score (Number of pellets hoarded in 30 minutes). Food intake and body weights during two estrus cycles alterations after ovariectomy and after estrogen injections in 10 female rats.

Mean \pm S.E.M. Post-ovariectomy hoarding score significantly increased on injection of estrogen ($P < 0.001$).

P - Proestrus E - Estrus M - Metestrus

D - Diestrus OvX - Ovariectomy.

Arrow pointed upwards (\uparrow) indicates the days of injections.

after progesterone administration. Fig. 1 displays the hoarding pattern of 13 animals before and after ovariectomy and administration of progesterone. Fig. 2 depicts the hoarding pattern of 10 animals before and after ovariectomy and after administration of estrogen. The animals in the present series were observed to have developed hoarding score after being food deprived for 22 hours a day for 8 days. The food intake and body weight though reduced under this schedule, showed cyclic variations as in animals fed *ad libitum*.

It was observed in earlier studies (unpublished data) that the hoarding score in rats after ovariectomy largely depended upon the time of ovariectomy. This was confirmed in the present two series in which the score remained high in those animals in which the operation was carried out during proestrus (Fig. 1), and lower in those operated at diestrus (Fig. 2). Subsequent injection of progesterone in high score group brought about in reduction of the score (Fig. 1) and injection of oestrogen in the low score group improved the hoarding score in the other group (Fig. 2). The present study thus indicates the role of ovarian hormones in hoarding. It seems possible that increased levels of estrogens at proestrus influences several body functions including tendency to hoard as much food as possible. It is known that at estrus the level of estrogens in the blood is slightly reduced as compared to that at proestrus (12). This is likely to reduce the hoarding score at estrus. Similar higher score at proestrus and lower one at estrus has been reported by Herberg *et al.* (5). The hoarding is also likely to be influenced by progesterone which is secreted in metestrus and diestrus. This is apparent in the reduced hoarding score observed in the animals after progesterone administration. In the intact body it is likely that higher levels of estrogens at estrus enhance the hoarding behavior and the same is attenuated in metestrus and diestrus because of higher blood levels of progesterone. The hoarding behaviour in these phases is influenced by the balance between the roles played by these two hormones which continue to be secreted. In the adult female estrogen exerts the limiting effect on food intake and body weight to a level well below that of the male (8). It is known that a freely fed female is subject to self imposed dietary restriction which would presumably release hoarding behaviour. In the present series the food intake and body weight were reduced at estrus but the hoarding score improved markedly at proestrus.

Herberg *et al.* observed that animals had higher scores at proestrus, metestrus and diestrus, the least being at estrus (5). The present results do not support their findings possibly because of the fact that the food-deprived animals in their study were kept for hoarding for 10 min only in contrast with 30 min duration allowed in the present series. To test this hypothesis five animals were kept for hoarding for 10 min and the hoarding scores were compared to those with 30 min session. It is noted that hoarding score in

metestrus improved and attains the score documented by Herberg *et al.* The score in diestrus was however observed to be lower than that at estrus.

The present work elucidates the role of estrogen and progesterone in cyclic pattern of hoarding in female rats. These ovarian hormones are known to influence diencephalic areas (2). It remains to be seen whether the estrogen and progesterone sensitive receptor cells are situated in dorso-medial thalamus, caudate-putamen and neocortex constituting motivational system (1, 6, 9, 10). Intracerebral administration of estrogen or progesterone could elucidate the role of these hormones further.

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